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EFFECT OF CHANGING PRICES UPON INCOME TO LAND FROM CATTLE AND SHEEP RANCHING, AS ILLUSTRATED BY DATA FOR MONTANA, 1910 TO 1936

By

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NATURE OF LAND RENT

"Rent is the price paid for the services of land". 2/ To the economist it is thus comparable with wages paid to labor and interest paid for the use of money. Rent, wages, interest, and profits are the major distributive shares of the total national income. To the business man or to the farmer, rent is an item of expense which he has agreed to pay to his landlord. Because of the character of this type of rent, it may be called contractual rent. In an effort to calculate the rental value of land operated by its owner, a sum of money may be imputed to the land as rent or as income to land. These three types or definitions of rent are not always equal, but tend to bear certain relations to one another, as will be shown later.

Rent as an economic concept exists even when no sum is paid by one person to another. The owner-operator of a property receives rent on the property as a part of his total income. Rent may take the form of actual rentals or leases, or it may be interest on the investment in land. Taxes are a deduction from the rent received, and are imposed by various governmental units. The owner of a property receives rent for it, part of which is paid out in the form of taxes, and the remainder becomes a return on his investment.

Strictly speaking, rent is paid for the use of land only, and not for the use of improvements on the land. When these improvements cannot be detached, and when similar improvements are necessary in order to use the land efficiently rent is paid to cover both land and improvements. Capital has frequently been invested in the land itself, in clearing, draining, or irrigating, as well as on the land, for buildings, fences, or other improvements. Rent, as we ordinarily see it, consists partly of a return to land and partly of a return to previously invested capital.

1/ Arthur Roth, Jr., Assistant Agricultural Economist, Bureau of Agricultural Economics, United States Department of Agriculture, assisted in compiling the data presented herein, and in developing some of the ideas.
2/ Outlines of Economics, by R. T. Ely, T. S. Adams, M. O. Lorenz, and A. A. Young, 4th edition, p. 402.

"The rent of any piece of land is measured by the difference between the money value of the products obtained from it by the use of the most advantageous amounts of labor and capital and the money value of the products which could be obtained by the use of the same amounts of labor and capital on marginal land, or at the intensive margin of cultivation." 3/ Although the measurement of rent postulates the most efficient use of resources in two situations or alternative uses of resources, actually the standard of efficiency assumed is somewhat less than the absolute maximum, and is more nearly that attained by the "representative" or slightly above average operator. This method of calculation implies that it is possible to measure certain quantities rather exactly. Often this is not the case, and hence on lands used by the owner we cannot be sure just what the rental would be. This definition also implies that if an operator or a laborer can secure a higher income in one place than in another, he will move to the place where his income will be the greatest. People often become attached to particular surroundings, and are unwilling to leave even when their income could be increased thereby. Moreover, they are often unaware of opportunities elsewhere. When rent is calculated according to the above definition, it reflects all residual profits or losses from the business, since all production factors and all products sold or available for sale have been valued at going rates.

The income imputed to land is calculated by deducting from the gross income all items of operating expense, including in the latter wages to the operator and his family. It may be a negative amount, since in a particular year the gross income may be insufficient to pay all operating expenses. Over a period of years the income imputed to land is the same as rent, considering the latter as a distributive share of gross income. Contractual rent may differ considerably from income imputed to land, since rent contracts are generally in force over a period of years, and conditions may vary greatly between years. There is some reason to believe that contractual rent averages higher than income imputed to land, even for the average of a very long period. Contracts with respect to land are entered into more generally in periods of high prices and high income to land than in periods of low prices and low income to land. Those who enter into these contracts rather generally over-estimate long-time average income possibilities.

Most range land is capable only of furnishing forage for range livestock and has no alternative use. The labor and capital that must be used in connection with such land in order to produce beef or lambs and wool will usually have a value in some alternative use. If we can estimate the alternative income of the labor and capital, the difference between this amount and the total income can be considered as income to land. Often the most feasible way of estimating the income of labor and capital in alternative uses is to ascertain what is paid for similar grades of labor and for capital when these are hired, in the same locality and under similar conditions. Income to land, as calculated in this report, is the difference between gross income and the expenses of operation, including in the latter wages to the operator and his family, all cash costs of operation, an allowance for replacement of necessary buildings and equipment, taxes and interest on items other than land. Taxes on land are not included, since these are paid out of the income to land.

3/ Ibid, p. 409

CALCULATION OF INCOME TO LAND

In calculating income to land of a particular type and in a given location, several questions arise as to the best procedure. Shall we estimate or calculate average physical production and amounts of materials required, and value these at prevailing prices at a given time? By so doing the effects of changing prices will be shown, unobscured by changes in other factors. Or shall we include changes in physical production and in amounts of materials required, as well as changes in prices? In many cases widespread droughts reduce the amount of beef or land produced, or severe winters increase the amount of feed required. To neglect these factors may give an erroneous idea of income to land in a particular year. The average rate of production and average amounts of materials used should take full account of bad as well as good years, however. Or shall we also include variations in production which occur on particular farms or ranches, but are not common in the area? Although most ranchers may be securing good returns and be able to pay a relatively large amount of rent, a particular rancher may fall much below the average of the community because of mismanagement or bad luck. In calculating income, shall we include only sales in the particular year, or shall we also include changes in inventory values? If we decide to do the latter, how shall we calculate inventory changes? We may value all animals in the herd or flock at the prevailing price, at the beginning and at the end of the year, and consider the difference between these two values as increased or decreased inventory. In periods of rapidly falling prices, this method may lead to a negative gross income; in periods of rising prices it may lead to a very large income. Another way is to value at prevailing prices only those animals which represent an increase in the herd or flock, or those which would be necessary to maintain the herd or flock at the same number. Consideration should be given to age and sex of animals in such a computation. If the rancher has 10 more heifers now than a year ago, the value of these heifers at present prices represents the increased inventory value, using this method of calculation; if he has 10 fewer heifers, the cost of these heifers represents the decreased inventory value.

The answer to the above questions depends, as is so often the case, on the purpose for which the calculation of income to land is being made, and the use to which this figure will be put. The following classification of purposes of computation or of use of results shows that under certain conditions one method is to be followed, and under other circumstances a different method:

(A) Relation of income to land and prices of beef, lamb and wool produced and of materials used in production. In this case, average rates of physical production and of physical quantities of materials should be used. The resulting income to land will not coincide with that actually secured by ranchers, if production conditions deviate from average. The effect of the one factor—changing prices—will be shown clearly and unobscured by other factors. Over a period of years, income to land as calculated in this way will tend to approximate income to land actually secured by ranchers, if the average production and input rates were determined correctly.

(B) Determination for a particular year of the ability of groups of ranchers to pay rent, including interest, taxes, etc. In such cases, adjustment should also be made for variations in physical production or in amounts of materials used in production. If the purpose is to determine what an individual rancher can pay, variations in his production and input rates will have to be considered.

(C) Determination of cash income of ranchers in an area. If this is the purpose of a calculation, only sales of stock should be included with income, and no allowance made for changes in inventory. Operating expenses such as family labor allowance, part of the depreciation cost, etc., must be included in a complete analysis of costs, but do not represent cash outlay in a particular year and hence, would be omitted for this purpose.

(D) Determination of amount of income to land earned in a particular year. For this purpose, changes in inventory should be considered as well as changes in prices and production. The method of calculating inventory changes in turn depends on the basis on which the ranch is being considered.

(1) On a continued operation basis, changes in inventory value should be calculated by applying prevailing prices to changes in numbers of livestock. The animals which would have been sold or would have been purchased if numbers in the breeding herd had remained constant, should be valued at going prices for animals of that age, class, and sex. The ranch which continues to operate cannot take advantage of high prices for all of its livestock, nor is it forced to accept low prices for its breeding stock.

(2) On a liquidation basis, all the animals in the herd or flock must be valued at the price at which they can be sold. This process is valid only if we are actually willing to consider liquidation of the ranch. Otherwise, the gains or losses apparently existing are not realized.

In this report, A or the first of these general objectives has been put foremost. The actual data used do not fulfill the requirements exactly, but do so well enough to illustrate the effect of changing prices. Although the data for cattle ranching do not show the effect of varying production conditions, conclusions as to ability of ranchers to pay rent in a particular year are not impaired materially thereby. The data for sheep ranching do show the effects of production conditions, but do not include inventory changes in gross income. This may result in some year-to-year differences from the figure we would choose, but in little difference over a long period.

AVAILABLE DATA ON CATTLE RANCHING IN MONTANA

"———over a series of years there is available as an annual average a fairly definite sum of money per animal unit to sustain the land charge in the form of interest on land investment, land taxes, land leases, or some combination of these different forms which the land charge may take". 4/ On the basis of studies of ranch business, Saunderson has calculated the operating costs and returns under typical or average production conditions in Montana. Calculating from his figures on a per animal unit basis, the operating costs for a cattle ranch with 200 animal units in cattle were $3,200 in the 1929-33 period (table 1). Half of this cost is for labor, which on a ranch of this size could be largely furnished by the operator and his family. Nearly 20 percent more is interest on investment in cattle and equipment, and part of the remainder is depreciation. Cash costs of operation in any year may be, therefore, only a small portion of the total of $3,200.

Gross income from such a ranch would be largely from beef sold, but would include miscellaneous items as well. Saunderson calculates that it would be $20 per head when beef was selling for $6.50 per 100 pounds. The annual gross income from our typical ranch would be $4,000, leaving $800 as the amount available to pay rent on land. Taxes on land must be paid from this amount, and it is entirely possible that they will absorb the whole sum. In that case, there would be nothing left for interest on investment. If part of the land used is secured very cheaply, a higher price can be paid for the rest. Although the total amount that can be considered as rent is fairly definite, the amount of this which will be paid for grazing or feed in different seasons depends to a large extent upon the relative supply of each type of land. If hay lands are scarce, competition may force their price up, lessening the value of grazing lands.

The above calculations are on the basis of average management and operating conditions. "Range cattle outfits operating on a cow and calf basis will run about one-fourth higher in operating costs than those shown above, and outfits running their steers to three years of age will, as an average, run about one-fourth lower than the above operating cost averages; but generally their gross income will also vary proportionately." 5/ Individual operators may be able to secure somewhat better results than shown in table 1, and of course some will do a good deal worse. Although this budget shows the amounts which can be credited most logically to the different items, there is nothing to prevent a rancher using part of his salary or of his interest on investment in cattle for paying rent on land. If the labor is hired, if money is owed on the cattle, and if buildings and machinery are maintained, only the amount allowed for land rent can be spent for this purpose.

The data in table 1 relate to normal or average production conditions, but to prices existing in the 1929-33 period. Prices and indexes are available whereby the data in table 1 can be computed for particular years since 1910 (table 2). Except for the index on taxes, the available indexes relate

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4/ "Some Materials Relating to Livestock and Land Valuation," by M. H. Saunderson. Department of Agricultural Economics, Montana State College. (Mimeographed) 1936.

5/ Ibid, p. 3.

Table 1. - Probable ranch operating costs of a range cattle ranch of 200 animal units of cattle, Montana, average 1929-33 1/

Item	Cost
	Dollars
Labor (including family living)	1600
General expense	350
Feed and salt	300
Depreciation on equipment and improvements	200
Taxes on cattle and equipment	150
Interest on investment in cattle and equipment (6 percent on a $45 value per cattle unit, and a $5 investment in equipment per cattle unit)	600
Total 2/	3200

1/ An animal unit is defined as a range cow weighing about 1000 pounds. A 2-year-old steer equals 0.85 animal units and a yearling steer about 0.65 animal units.

2/ Does not include taxes on land, land leases, or interest on investment in land. Based on "Some Materials Relating to Livestock and Land Valuation" by M. H. Saunderson, mimeographed by Montana State College, Agricultural Experiment Station.

Table 2. - Prices and cost indexes used in computing income to land from cattle ranching in Montana, 1910-36

Year	Average farm price of beef per cwt. 1/	Index of production costs (1910-14 = 100)			
		Family living 2/	Farm wages 2/	Production 2/	Taxes 3/
	Dollars				
1910	5.49	98	97	98	100
1911	5.04	100	97	103	100
1912	5.75	101	101	98	100
1913	6.68	100	104	102	100
1914	6.68	102	101	99	102
1915	6.47	107	102	104	107
1916	7.02	124	112	124	113
1917	8.86	147	140	151	130
1918	9.87	177	176	174	137
1919	9.92	210	206	192	171
1920	9.13	222	239	174	191
1921	5.42	161	150	141	202
1922	5.52	156	146	139	187
1923	5.87	160	166	141	182
1924	5.57	159	166	143	178
1925	6.10	164	168	147	175
1926	6.28	162	171	146	182
1927	6.98	159	170	145	174
1928	9.20	160	169	148	172
1929	9.10	158	170	147	185
1930	7.24	148	152	140	183
1931	5.10	126	116	122	172
1932	3.82	108	86	107	162
1933	3.45	109	80	108	151
1934	3.34	122	90	125	149
1935	5.61	124	98	126	142
1936	5.26	122	107	126	132
Average 1910-36	6.47	140	136	132	151

1/ "An Analysis of Montana Farm Prices" by P. L. Slagsvold. Montana State College Bul. 345, 1937.

2/ For the United States as a whole. Published currently in the Agricultural Situation and in Agricultural Statistics. U. S. Dept. Agr.

3/ For Montana, Unpublished series furnished by R. R. Renne, Montana State College.

to the United States as a whole and include a somewhat different group of commodities than does the typical cattle ranch budget. However, the trend of all the indexes is remarkably similar, and more precise indexes would serve to refine the series of operating costs and returns, but would not change the general relations found to exist.

As computed in table 3, the different items of the total operating expense, the gross income, and income to land from cattle ranching in Montana varied greatly in the years from 1910 to 1936. Total costs varied from less than $2,400 to over $5,100, the cost in 1920 thus being more than twice the cost in 1933. All items of cost shared in this variation, the general trend of all items except taxes being similar. Gross income varied from less than $2,100 to over $6,100, or a considerably wider range of variation than was found for operating costs. As a result of these variations in gross income and operating costs, income to land varied from a negative figure of nearly $600 to a maximum of over $1,600. In eight of the 27 years, the income to land was negative. Five of these eight years of negative income to land were in succession. There were nine years when the income to land exceeded $1,000, and seven of these were in succession.

In the pre-war period gross income was nearly average for the entire period, operating costs were low, and income to land was above average. During the war, costs rose less rapidly than gross income, and income to land increased. The purchasing power of this increased monetary income to land was less than in the pre-war period, however. After the war, costs fell less rapidly than prices of beef, and income to land became negative, remaining so through 1925. Just before the depression income to land rose almost to war-time peaks. During the depression it became negative again. On the whole, the post-war period has been distinctly less profitable for cattle ranchers than was the pre-war period.

When calculated income to land was negative, other factors of production could not be paid for at market rates. The operator was forced to accept lower wages or a lower rate of interest on his investment than he might have secured elsewhere, or to invest additional capital in the business in order to pay market prices for labor and capital, if these were hired. When income to land was high, the operator would probably expect wages or interest higher than prevailed in the market, to offset the lower-than-market rates he had previously accepted. Most ranchers have some contractual rent to meet, and nearly all of them have land tax obligations even when the calculated income to land is negative. Because of this divergence between income earned by land in a particular year and contractual rent, the actual distribution of income to pay for productive services or materials differs considerably from what it would be in the absence of any contracts. Agreements made in the past, prevent adjustment to the new situation. Contractual rent, including taxes, must be paid from wages or interest on investment in cattle, or from a source outside of the ranch. Buildings and equipment would be maintained only to the extent absolutely necessary, in order to effectuate savings in cash outlay in periods of low income.

Table 3.--Operating costs, gross income, and income to land for a typical cattle ranch operating 200 animal units of cattle in Montana, 1910-36 1/

Year	Expenses of operation					Gross income 6/	Income to land 7/
	Labor 2/	General, feed and depreciation 3/	Taxes 4/	Interest 5/	Total		
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
1910	1238	664	88	507	2497	3379	882
1911	1263	698	88	466	2515	3102	587
1912	1289	664	88	531	2572	3539	967
1913	1302	692	88	617	2699	4111	1412
1914	1289	671	90	617	2667	4111	1444
1915	1340	705	94	598	2737	3982	1245
1916	1506	841	99	649	3095	4320	1225
1917	1837	1024	114	819	3794	5452	1658
1918	2246	1180	121	912	4459	6074	1615
1919	2654	1302	150	917	5023	6105	1082
1920	2935	1180	168	844	5127	5619	492
1921	1991	956	178	501	3626	3335	-291
1922	1927	942	165	510	3544	3397	-147
1923	2080	956	160	542	3738	3612	-126
1924	2080	970	157	515	3722	3428	-294
1925	2118	997	154	564	3833	3754	- 79
1926	2131	990	160	580	3861	3865	4
1927	2093	983	153	645	3874	4295	421
1928	2105	1003	151	850	4109	5662	1553
1929	2093	997	163	841	4094	5600	1506
1930	1914	949	161	669	3693	4455	762
1931	1544	827	151	471	2993	3139	146
1932	1238	725	143	353	2459	2351	-108
1933	1199	732	133	319	2383	2123	-260
1934	1353	848	131	309	2641	2055	-586
1935	1416	854	125	518	2913	3452	539
1936	1455	854	116	486	2911	3237	326
Av. 1910-36	1764	897	133	598	3392	3984	592

1/ On the basis of the typical ranch budget shown in table 1, and with costs adjusted by prices and cost indexes shown in table 2.

2/ Adjusted by use of farm family living and farm wage indexes, each weighted equally. Labor cost $1,600 in the 1929-33 period when the index was approximately 125, or cost $1,276 in the base period.

3/ Adjusted by use of production index. Cost was $850 in the 1929-33 period when the index was approximately 125, or $678 in the base period.

4/ Adjusted by use of the index for taxes. Does not include taxes on land. Cost was $150 in the 1929-33 period when the index was approximately 171, or $88 in the base period.

5/ On investment in cattle, machinery, and other liquid capital, at 6 percent. Amount of investment calculated as proportional to the price of beef, and taken as $50 per head when cattle were $6.50 per cwt.

6/ Includes miscellaneous income as well as cattle sold, but calculated in proportion to price of beef. Gross income $20 per head of cattle when beef was $6.50 per cwt.

7/ Difference between gross income and operating costs. Is amount from which taxes on land and interest on investment in land must be paid.

Not only did the income attributable to land fluctuate widely, but the other sources of the rancher's income also varied greatly and in a similar fashion. When prices were high and income to land was relatively high, the rancher received high wages for the work he did, and the amount of interest received on the investment in cattle was large. A considerable amount of money was available with which to pay taxes and interest on land, if he wished to use it in that way. When prices were low and income to land was low, the rancher's wages were reduced and interest on the investment in cattle was less. There were fewer places in his budget from which to squeeze out money to pay taxes and interest on land, than there had been when prices were high.

AVAILABLE DATA ON SHEEP RANCHING IN MONTANA

Prices of lamb and wool have varied greatly since 1910, materially affecting gross income from sheep production (table 4). Lambs averaged only $3.86 per 100 pounds live weight in 1932, compared with $13.87 per 100 pounds in 1918, and a price above $10 per 100 pounds each year from 1923 through 1929. Wool prices also fell to a low in 1932, and were at a peak in 1918 and 1919. The index of lamb and wool prices had a range of 217.1 points, from a low of 62.6 in 1932 to a high of 279.7 in 1918. The high point was, therefore, over four times the low point, the low was less than half the average, and the high 180 percent of the average. These fluctuations in price were considerably more extreme than those found for beef.

The result of these fluctuations in prices has been a highly variable gross income from sheep ranching in Montana since 1910 (table 5). Since five sheep are usually considered equal to one animal unit, a 1000-head sheep outfit has the same number of animal units as a 200-animal-unit cattle outfit. Total forage requirements for the year should be about the same for 200 animal units of sheep as for the same number of animal units of cattle. Seasonal forage requirements might be different, however, since practically all growth of lambs is made in a comparatively short period in the summer, whereas young cattle normally grow throughout the year. The income from sheep ranching in table 5 includes only sales in the particular year, and, hence, the annual earnings of the ranch may have fluctuated in a somewhat different fashion. Over a period of years, income from sales should equal income adjusted for inventory changes. The range in gross income from 1000 sheep is from less than $2,500 in the pre-war years to over $8,000 in the war period.

Operating costs on the typical sheep ranch varied from $2,300 to over $6,000 in the 1910-1932 period. The years of highest operating cost were just prior to the depression, while the years of highest gross income were during the World War. Income to land varied from a negative sum of more than $1,400 to a high of nearly $4,000. This is a much greater range than was found for cattle ranching. Income to land was low in the pre-war period, rose to great heights during the war, fell to its lowest point immediately after the war, but rose quickly, and stayed high during most of the 1920's. Costs rose so much that income to land declined before the depression began. It is possible that cash incomes were low in some years because an unusually large number of ewe lambs were held back for replacement purposes.

Table 4. - Prices paid to farmers for lamb and wool, and index of lamb and wool prices combined, in Montana, 1910-36

Year	Prices paid to farmers for: Lambs per cwt.	Prices paid to farmers for: Wool per pound	Index of lamb and wool prices (1910-14 = 100)
	Dollars	Cents	
1910	1/ 5.50	1/ 18.0	2/ 98.0
1911	5.38	17.0	94.3
1912	5.70	18.9	102.2
1913	5.77	17.5	99.1
1914	6.41	18.0	106.4
1915	6.88	24.9	128.8
1916	8.07	29.6	152.1
1917	12.25	48.4	240.1
1918	13.87	57.8	279.7
1919	12.64	58.0	268.9
1920	11.62	41.8	216.9
1921	6.62	19.0	110.9
1922	9.52	33.5	175.8
1923	10.20	38.8	196.0
1924	10.18	39.3	197.1
1925	11.85	40.8	216.4
1926	11.25	35.0	195.6
1927	10.87	32.8	186.4
1928	11.23	37.8	202.8
1929	11.27	32.8	190.1
1930	7.48	22.5	128.1
1931	5.10	15.2	87.0
1932	3.86	10.3	62.6
1933	4.54	18.8	91.2
1934	5.38	23.5	111.3
1935	6.47	19.5	110.8
1936	7.42	26.4	137.7
Average 1910-36	8.42	29.5	155.0

1/ Estimated. Based on "An Analysis of Montana Farm Prices," by P. L. Slagsvold, 1937, Montana State College Bull. 345.

2/ Over a period of years the income from wool production has about equalled the income from sale of lambs. For each one pound of lamb sold, .28528 pounds of wool were sold. Index = Lamb price per pound + .28528 wool price per pound.

Table 5. - Operating costs, gross income, and income to land for a typical sheep ranch with 1000 sheep, Montana, 1910-32 1/

Year	Operating costs 2/	Gross income 3/	Income to land 4/
	Dollars	Dollars	Dollars
1910	2,299	2,480	181
1911	2,420	2,800	380
1912	2,440	2,490	50
1913	2,525	2,810	285
1914	2,625	3,040	415
1915	2,800	4,300	1,500
1916	3,420	4,920	1,500
1917	4,040	8,020	3,980
1918	5,250	8,540	3,290
1919	5,660	7,920	2,260
1920	5,615	4,610	-1,005
1921	4,345	2,900	-1,445
1922	4,285	5,070	785
1923	4,525	5,710	1,185
1924	4,880	6,220	1,340
1925	5,190	5,740	550
1926	5,440	6,240	800
1927	5,705	6,620	915
1928	6,205	7,270	1,065
1929	5,540	5,670	130
1930	5,170	4,220	- 950
1931	3,950	3,050	- 900
1932	3,460	2,650	- 810
Average 1910-32	4,252	4,926	674

1/ The items in this table are not exactly comparable with items of the same title in table 3. See page 6 and footnotes at bottom of the respective tables for differences and definition of terms.

2/ Includes wages to operator and his family, taxes and interest on sheep and equipment, depreciation and general operating expenses, each calculated at prices prevailing in respective year. Does not include taxes or interest on land, or land leases and rentals.

3/ Includes sales only, and not inventory changes.

4/ Difference between gross income and operating costs; is available to pay taxes, interest, and rent.

Based on table 20, page 43, Montana State College Bull. 302, June 1935, "Economics of Range Sheep Production in Montana," by M. H. Saunderson and Louis Vinke.

COMPARISON OF INCOME TO LAND FROM CATTLE RANCHING AND FROM SHEEP RANCHING

In the major movements of gross income, operating costs, and income to land since 1910, cattle and sheep ranching are similar (table 6 and fig. 1). Income to land from cattle and sheep was comparatively stable in the pre-war period, rose during the war, fell sharply thereafter, rose again sometime before the depression, fell during it, and has started to recover since. In a more detailed comparison of income to land from the two types of ranching, considerable differences show up, however. Cattle ranching returned a much larger income to land than did sheep, in the pre-war period. During the war years this relation was reversed. After the war, income to land from sheep ranching fell sooner and further than did income to land from cattle ranching; but sheep ranching recovered sooner and made relatively good returns through 1928. The favorable war and post-war period, with the exception of 1920 and 1921, was a major factor in increased numbers of sheep in all major parts of Montana, and in the West generally. During the depression, sheep ranching was apparently less profitable than cattle ranching, but started to recover sooner.

When compared for a long period, cattle and sheep ranching are able to earn almost exactly as high an income to land, if 5 sheep are considered equal to one animal unit. The 23-year average (1910-1932) gives cattle a slight advantage; the 27-year average (1910-36) gives sheep an equal advantage. The marked variation in returns between the two types of operation in particular periods averages out over a long period, until the two are about equal. Sometimes the cattleman is more prosperous and able to bid higher for range; other times the advantage is with the sheepman. Some types or tracts of range are so much better suited to cattle or to sheep that they are more valuable in the use to which best adapted than in any other use, under any price relations thus far encountered.

Variations in cost of operation have followed a similar trend with cattle and sheep ranching, except that costs for sheep rose in the latter part of the 1920's far more than did costs for cattle.

RELATION OF INCOME TO LAND AND PRICES

Prices of beef, lamb, and wool vary over a wider range and tend to vary more from year to year than do prices of production materials. There are periods of relatively constant costs of operation, within which prices of products sold dominate income to land. In such periods there is a direct relation between the prices received and the income to land. As will be shown later, the relation is not a simple proportionate one. Increasing or decreasing livestock prices by 10 percent changes the income to land much more than 10 percent. This relationship is illustrated for cattle ranching in figure 2. The income to land per animal unit month of grazing, as shown in table 6 is represented by the vertical scale while the price of beef as shown in table 2 is represented on the horizontal scale. Thus, in 1910, beef cattle sold for $5.49 per 100 pounds and income to land per animal unit month of grazing was 37 cents. In 1911 the price of beef cattle was $5.04 per 100 pounds and income to land fell to 24 cents per animal unit month of grazing.

Table 6.--Gross income, operating expenses, and income to land for typical cattle and sheep ranches in Montana, 1910-36

Year	Cattle (200 a.u.) 1/				Sheep (1000 head) 3/			
	Gross income	Operating expenses	Income to land		Gross income	Operating expenses	Income to land	
			Total	Per a.u. mo. 2/			Total	Per a.u. mo. 2/
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
1910	3379	2497	882	.37	2480	2299	181	.08
1911	3102	2515	587	.24	2800	2420	380	.16
1912	3539	2572	967	.40	2490	2440	50	.02
1913	4111	2699	1412	.59	2810	2525	285	.12
1914	4111	2667	1444	.60	3040	2625	415	.17
1915	3982	2737	1245	.52	4300	2800	1500	.62
1916	4320	3095	1225	.51	4920	3420	1500	.62
1917	5452	3794	1658	.69	8020	4040	3980	1.66
1918	6074	4459	1615	.67	8540	5250	3290	1.37
1919	6105	5023	1082	.45	7920	5660	2260	.94
1920	5619	5127	492	.20	4610	5615	-1005	-.42
1921	3335	3626	-291	-.12	2900	4345	-1445	-.60
1922	3397	3544	-147	-.06	5070	4285	785	.33
1923	3612	3738	-126	-.05	5710	4525	1185	.49
1924	3428	3722	-294	-.12	6220	4880	1340	.56
1925	3754	3833	- 79	-.03	5740	5190	550	.23
1926	3865	3861	4	.00	6240	5440	800	.33
1927	4295	3874	421	.18	6620	5705	915	.38
1928	5662	4109	1553	.65	7270	6205	1065	.44
1929	5600	4094	1506	.63	5670	5540	130	.05
1930	4455	3693	762	.32	4220	5170	-950	-.40
1931	3139	2993	146	.06	3050	3950	-900	-.38
1932	2351	2459	-108	-.05	2650	3460	-810	-.34
1933	2123	2383	-260	-.11	3050 4/	3400 4/	-350	-.15
1934	2055	2641	-586	-.24	4150 4/	3950 4/	200	.08
1935	3452	2913	539	.22	4260 4/	4120 4/	140	.06
1936	3237	2911	326	.14	5360 4/	4230 4/	1130	.47
Av. 1910-32	4204	3510	694	.29	4926	4252	674	.28
Av. 1910-36	3984	3392	592	.25	4919	4203	616	.26

1/ From table 3.
2/ Dividing the total by 2,400 animal unit months.
3/ From table 5.
4/ Estimated from other sources.

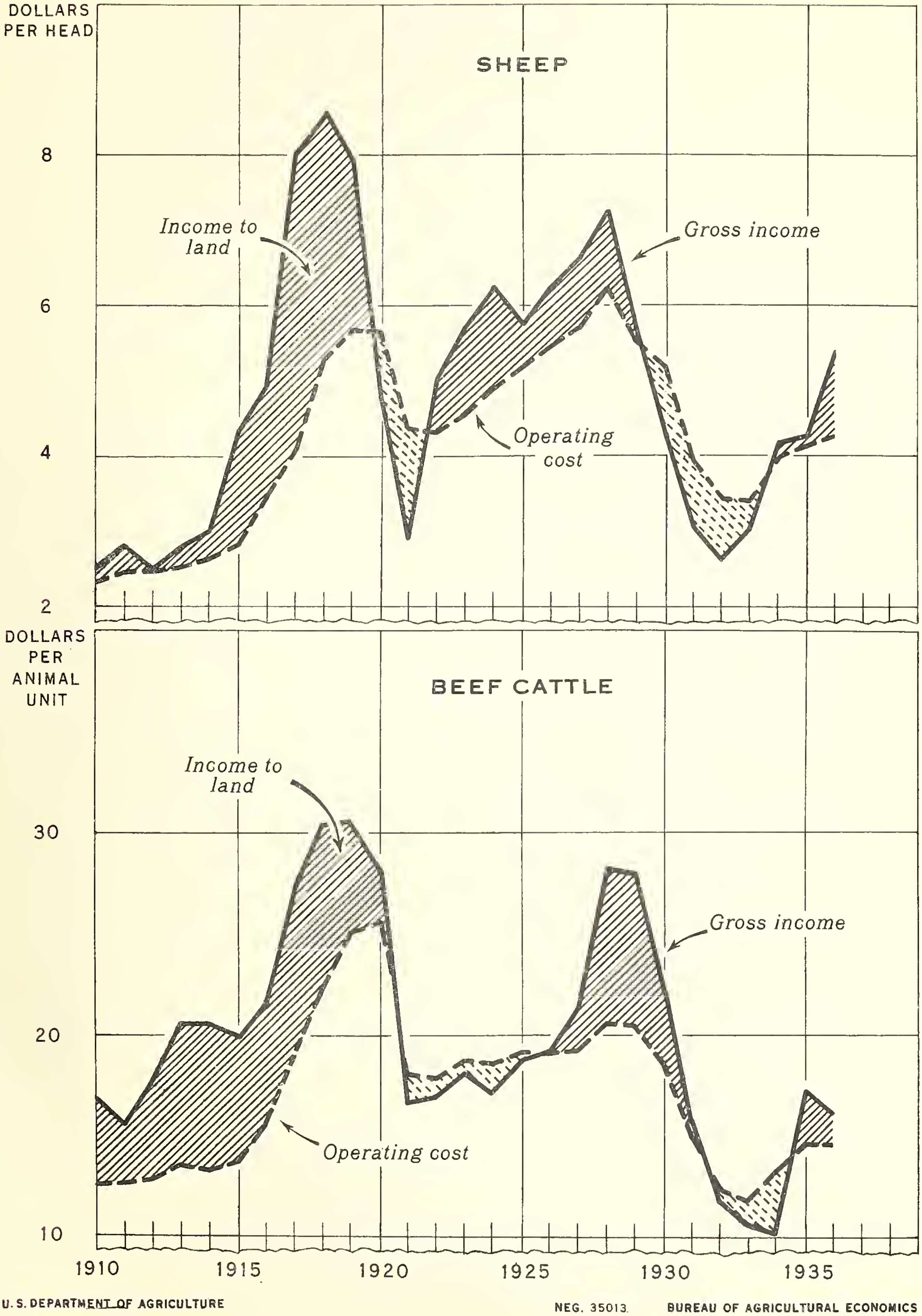
DOLLARS PER HEAD
SHEEP
8
6
4
2
Income to land
Gross income
Operating cost
DOLLARS PER ANIMAL UNIT
BEEF CATTLE
30
20
10
Income to land
Gross income
Operating cost
1910
1915
1920
1925
1930
1935
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FIGURE 1

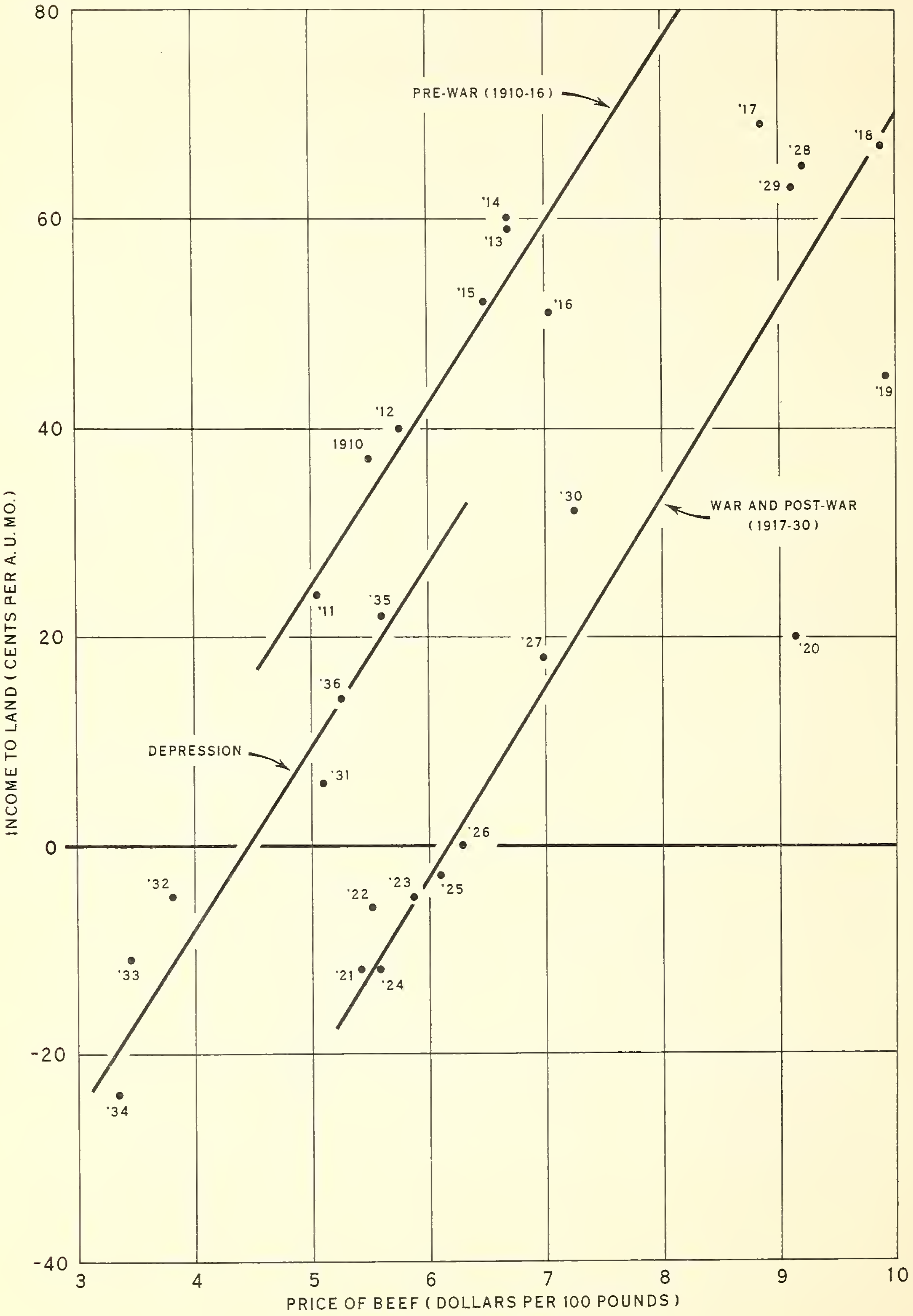

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FIGURE 2

The three periods during which costs were at a relatively constant level are designated as (1) pre-war, (2) war and post-war prosperity, and (3) depression. From 1910 to 1916, inclusive, the income to land per animal unit month of forage, was closely responsive to the price of beef. From 1917 to 1930, a less close but still high degree of correspondence was found. In 1917, beef prices had risen very greatly but costs had risen less rapidly. In 1919 and 1920, costs fell more slowly than did beef prices. The other years fall fairly close to the line of relationship that has been drawn. These lines are not mathematically fitted regression lines, but are visual estimates of average relations. In the depression, costs had fallen nearly to the pre-war level, and a given price of beef resulted in a higher income to land than the same price of beef would have brought during the war period. In each period a rise in price of $1.00 per 100 pounds resulted in an increase in income to land of nearly 18 cents per animal unit month of grazing.

The relation between beef prices and income to land from cattle ranching is presented in a different way in table 7. Although beef prices did not move through a wide enough range in each period to show us at what price there would have been no income to land and at what price there would have been a return of 50 cents per month's grazing, by extending the lines of average relations we can calculate the respective prices. In the pre-war period, when costs were low, no income to land was available when beef was $3.50 per 100 pounds live weight; under the higher cost conditions of the war and post-war period, the price had to be $6.20 in order for the rancher to escape a negative income to land. The prices at which the income to land was 50 cents per head per month were $6.40 and $8.90, respectively. The depression years are intermediate at both levels of income to land.

Table 7. - Price of beef per 100 pounds live weight at which cattle grazing had specified value in Montana

Period	No income to land	Grazing worth 50 cents per animal unit month
	Dollars	Dollars
Pre-war	3.50	6.40
War and post-war prosperity	6.20	8.90
Depression	4.50	7.30

A generally similar relation exists between income to land from sheep ranching and prices of lamb and wool. The index of wool and lamb prices as shown in table 4 is represented on the horizontal scale and the income to land per animal unit month of grazing as shown on table 6 is represented on the vertical scale. Thus in 1910 the index of prices was 98 and income to land per animal unit month was 8 cents. In 1911 both lamb and wool prices were slightly lower, so that the index stood at 94.3. In spite of this, income to land was slightly higher. The data for later years were plotted in similar fashion.

In the case of sheep ranching, depression and pre-war cost conditions are sufficiently similar that the two can be combined in one line (fig. 3). Again, 1917, 1919, 1920 deviate farther from the lines of average relationship than do other years, and for the same reasons as did the income to land from cattle ranching in those years. In the case of sheep, the extreme values of income to land are farther apart than were the extreme values for cattle ranching. An average of the pre-war depression and war-post-war-prosperity relations indicate that a rise of 10 points in the index of lamb and wool prices resulted in a rise in income to land of nearly 14 cents per animal unit month of grazing. When costs were low, as in the pre-war-depression periods, a given rise in the price index resulted in a somewhat larger increase in income to land than did the same increase in the price index in a period when costs were higher, as in the war-post-war-prosperity periods.

A comparison of the index numbers at which sheep ranching produced no income to land and at which it produced 50 cents per animal unit month grazing are shown in table 8.

SIGNIFICANCE OF RESULTS

The foregoing results, showing the relation of income to land with prices of products sold and materials bought, are significant to the rancher, to loan agencies, and to Federal and State agencies charged with administration of public range lands. Each of these persons or agencies has specific problems and situations, into which the results presented thus far will fit in different ways.

To Ranchers

The rancher's income, not only to land but also to himself as a worker and as a capitalist with an investment in cattle or sheep, is dominated by price changes out of his control, acting as an individual. Faced with income changes out of his control, he must so govern his affairs as to take maximum advantage of higher-than-average income and to minimize the inconvenience of less-than-average income. In periods of high income, existing indebtedness can and should be reduced, or reserves built up if no indebtedness exists. This is the traditional advice given to all persons faced with fluctuating incomes, and it is generally sound. Some ranchers have done a great deal in this direction, and have thus materially improved their situation. The average Montana cattle or sheep rancher, as represented by the data presented in table 6, could have accumulated a considerable surplus in the 1914-1919 period, which would have assisted him greatly in 1920 and 1921.

There are great obstacles to be overcome before accumulation of reserves in good times to meet deficits in bad times is a complete solution to the problem of widely fluctuating income. The fact that good years may occur in succession, and bad ones likewise, makes it difficult to build up a sufficiently large reserve. Protection of a reserve sufficient in size to enable the rancher to level out his income is a large task. This would have been particularly true in the post-war depression and the one beginning in 1930, when bank failures were numerous and most types of securities fell greatly in value. The fact that good years occur in succession, perhaps several years in length, is likely to lead the rancher and others to believe that such years are normal and he will plan his expenditures accordingly.

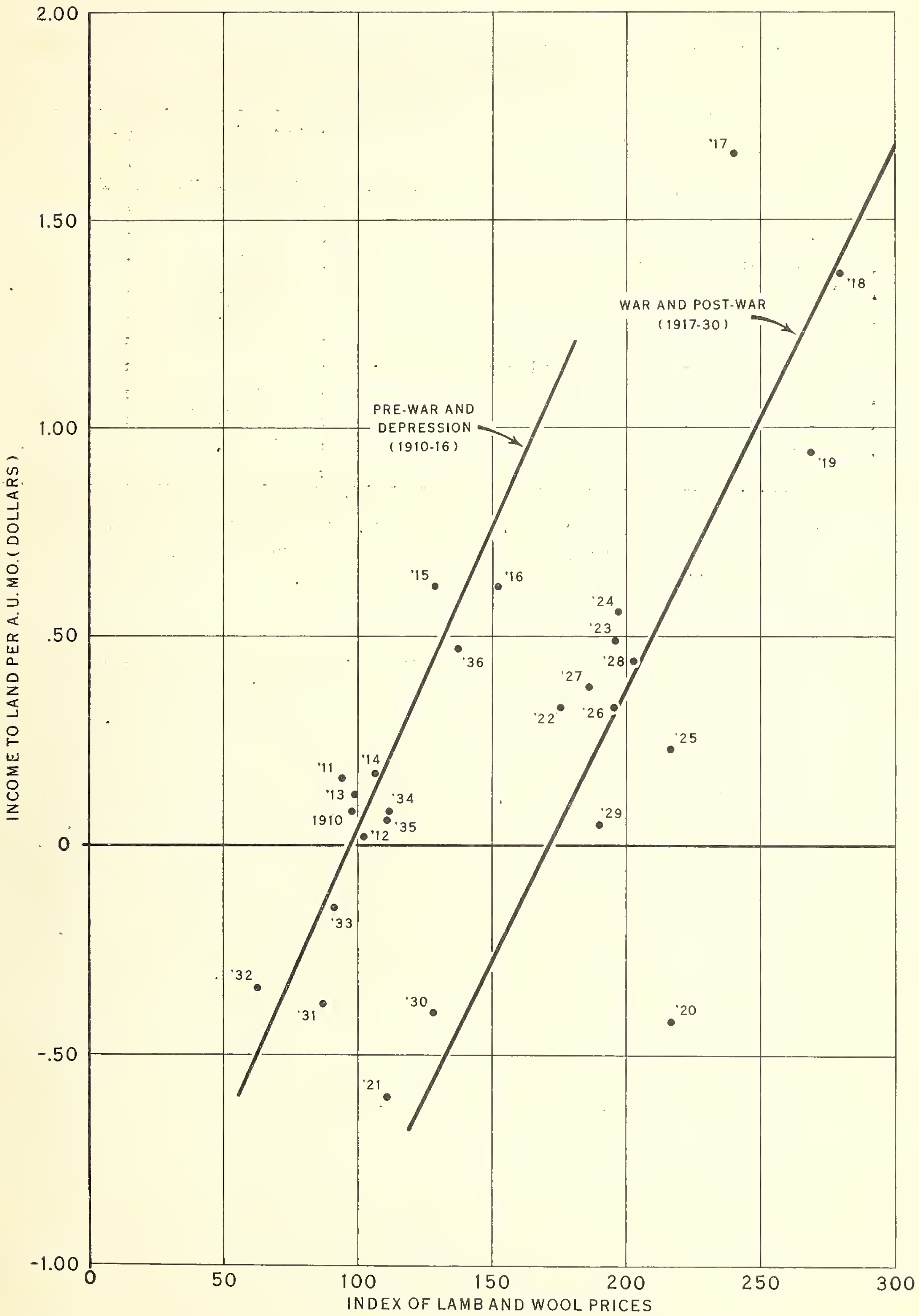

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FIGURE 3

Table 8. - Price index and prices of lamb and wool at which sheep grazing had specified values in Montana

Prices and price indexes	Pre-war and depression conditions	War and post-war prosperity conditions
No income to land:		
1. Index of lamb and wool prices	100	172
2. Lamb price per 100 pounds 1/	$5.75	$9.89
3. Wool price per pound 1/	17.9¢	30.8¢
Grazing worth 50 cents per animal unit month:		
1. Index of lamb and wool prices	135	211
2. Lamb price per 100 pounds 1/	$7.77	$12.14
3. Wool price per pound 1/	24.1¢	37.7¢

1/ These prices are used on the assumption that lamb and wool prices changed in exactly the same proportion. Actually, wool prices may have been higher or lower than this figure, if lamb prices were correspondingly lower or higher, to result in this average price change.

The recommendation that a rancher build up reserves in good times to tide him over bad times assumes that he was established prior to a period of high income, so that he could take advantage of the available surplus. A man who started cattle ranching in 1919 or 1920 found it impossible to accumulate a reserve until after 1927. By that time he was bankrupt or at least the capital with which he started was impaired. In 1928-30 he might have rebuilt his original capital values but could not have accumulated a large reserve. The man who was established during the war period may have accumulated some surplus, but it is hardly likely that he foresaw the duration of the low income period ahead.

In spite of the difficulties of accumulation of reserves and of debt retirement in good times, as a protection against bad times, it still remains the most effective device in the control of the individual rancher. It is one means whereby the prudent manager can succeed where others fail.

Accumulation of reserves in good years to provide as large an income in bad as in good years is a theoretical ideal to which a rancher might aspire. The difficulties in building up such a reserve and in investing it wisely so that it will be available when needed, call for a degree of financial skill beyond that of the average rancher, if indeed not beyond the ability of the average small-town banker. Somewhat the same result as is expected of reserves can be achieved by variations in expenditure during good and bad years. Buildings and fences can be built or improved when money is plentiful, and allowed to depreciate with only the more urgent repairs when money is scarce. The more durable items of equipment can be bought when incomes are large, and the old machines made to do in less prosperous times. An automobile or truck is a necessary piece of equipment on most ranches, for the ranch as a business and for the family. Purchase of trucks can often be postponed for a few years without serious difficulty.

Adjustments like these are commonly made by ranchers. Then, too, they tend to "live a little higher" when incomes are good than when they are poor. This is probably good economics, as well as a popular philosophy among ranchers.

Perhaps the most important consideration to the rancher, in connection with fluctuating income to land, is the avoidance of over-capitalization of relatively high income. When cattle are selling for 7 cents, 8 cents, or more per pound, many a rancher feels that if he could only acquire another ranch or some additional property, he could earn a really satisfactory income. He is likely to buy property, only to have to pay for it with 3-cent, 4-cent, and 5-cent cattle.

It is a matter of common observation that ranch property changes hands much more frequently in periods of high than in periods of low prices for livestock. Such property sells for more than its actual long-time average earning power will warrant. The rancher contracts to pay an amount of rent, in the form of taxes and interest, in excess of average amount by which gross income exceeds operating expenses. Contractual rent exceeds average income imputed to land. The interest charge which was not unreasonable with high prices becomes impossible to meet in years of low prices, when it may take all the income to pay operating expenses. Most ranch property is persistently and regularly over-capitalized, due in very large part to the cycles in livestock prices. The rancher who avoids buying property at a price above its actual long-time earning power is well started on the road to success. And "long-time" means more than the average of the past three or five years.

On the basis of the situation in Montana in 1910-36, as shown by table 6, an income to land of more than 25 cents per animal-unit month should be regarded with considerable interest, not to say suspicion. When income to land exceeds this amount, all or part of the excess should be applied to the retirement of existing indebtedness or to the accumulation of reserve. Under present banking regulations, country banks that are members of the Federal Deposit Insurance Corporation are far safer custodians of such reserves than were the old country banks. An income to land in excess of 25 cents per animal-unit month should be translated into land values only with the most extreme caution. These general conclusions can probably be applied to other parts of the West, with some modification.

To Loan Agencies

Fluctuating income to land from ranching is significant to loan agencies for several reasons. When income to land varies greatly, and for many years in succession above (or below) average, it is easy even for conservative lenders to be led astray and to make loans above the average value of the property. Correct appraisal becomes more difficult when the experience of the moderately recent past is such an unreliable guide. It is hard to allow for bad years which history shows occur, if the past few years that loom so distinctly in memory have been good ones. Fluctuating income to land makes correct land appraisal difficult.

The wide fluctuations in income to land from ranching that obtained in Montana from 1910 to 1936, mean that in a substantial portion of the years borrowers cannot expect to pay interest and/or principal payments out of current income. In some years, and generally for a series of years in succession, the average ranch has a financial struggle to keep operating, without paying any interest. If loan agencies insist on interest and/or principal payments in such years, the money must come from earnings saved in previous years, from the wages of the ranch operator, from liquidation of part of the ranch assets, from some source outside of the ranch, from borrowings from some other lender, or some combination of these sources. We have already seen that saving enough money in a series of good years to carry over the series of bad years which have been encountered in the past is a difficult proposition. In the years when there is no income to land, the rancher's wages are low and he is unable to use much of this income in paying interest on land. Additional credit is likely to be hard to secure, although this is the time it is needed the most.

A uniform annual repayment and a constant annual interest charge are ill-fitted to the character of income to land from ranching operations. Not only does such a policy encounter difficulties when livestock prices and income to land are low, but it is not adapted to periods when prices are high. If average annual payments only are expected when income to land is high, and it proves impossible to collect these payments when income to land is low, the period of repayment of a loan will be lengthened considerably, possibly to twice the length originally planned. Years of high income to land following a period of low income to land provide the rancher with the means to pay off accumulated delinquent interest charges. Frequently they enable him to pay off substantial amounts on his indebtedness as well.

It is to the rancher's interest to reduce his indebtedness in order to have as low fixed charges as possible in the next period of low prices. The loan agency should also be interested in such reduction of indebtedness, as strengthening its collateral. If the loan agency does not insist on comparatively large payments on indebtedness, the rancher may consume the relatively large income to land, or obligate it as payment for land.

Wide and sustained fluctuations in income to land make equal or nearly equal annual payments for interest or reduction of principal of loans impossible in periods of low prices, and unwise from the viewpoint of both lender and borrower in periods of high prices. The rancher needs additional credit at the very time when he is unable to pay interest on his existing indebtedness; and commercial loan agencies are generally unwilling to extend it at this time. Unless he pays back relatively large amounts when prices are high, his prospects of getting through the next depression are materially lessened, and the maker of the loan is in danger of becoming an "unwilling rancher". In the past, loan agencies have been very loath to restrict credit when livestock prices were high, or to extend it when prices were low. More often they have permitted and encouraged ranchers to expand when prices were high, and forced them to liquidate when prices were low.

To Public Land Administrators

The position of the administrator of public lands is in some respects similar to that of the lender. Grazing fees are a form of land rent, in the same way as are leases, taxes, and interest payments. When income to land is negative or very low, grazing fees must be paid out of the wages of the rancher, or from some source other than income to land. When income to land is relatively high, if grazing fees remain constant or vary only to a minor degree, there is a comparatively large sum of money which the rancher can use for other purposes than payment of rent. If saved, it strengthens his position for the next period of low prices; if spent for family living, it at least yields pleasures and satisfactions of some kind; but if used to acquire more land, particularly if used as interest on a comparatively large loan, it makes failure in the next period of low prices very probable.

The problem of the public range land administrator is thus different in the period of low income to land, and in that of high income to land. In the former, grazing fees can be paid only with difficulty. Protests from range users will often be so effective as to result in material reductions in fees, and the range user will be freed of his onerous and perhaps impossible burden. In periods of high income to land, grazing fees are paid with comparative ease, and at first glance no problem seems to exist. If income to all grazing land is high, and charges for some kinds remain comparatively low, the balance of the total income to land is likely to be used in bidding up the prices of private lands. The result is that private lands become grossly over-capitalized, not only because income to all land is above the long-time average, but because some types of land are credited with a portion of the income earned by other types of land. This over-capitalization of private land leads to an impossible debt burden in years when income to all land falls. Grazing fees on public ranges cannot be considered by themselves alone, but rather in their effect upon private land values, indebtedness, and ranch solvency.

Administrative problems might be encountered in attempting to vary grazing fees according to income to land. There would naturally be some problems encountered in measuring income to land, but these do not seem insurmountable. If all users of public range lands continued in operation throughout the high and low periods of a cycle, each would share in the high and low fees. Since there is some turnover in permittees each year, at a particular time there would be some operators who had paid high fees during some years and others who had paid only low fees. After the plan had been in operation for some time this would probably not be a serious factor. Under present fees there is often considerable discrepancy between fees on public lands and costs on private lands. If fees were to be varied according to income to land, with no change in the present tax, lease, or interest procedure, a still greater discrepancy would exist between grazing fees and private land costs. But it would then sometimes be a discrepancy of grazing fees above private land costs and sometimes a discrepancy of grazing fees below private land costs, and not always a matter of grazing fees being below private land costs, as at present. If grazing fees increased when income to land increased, demand for grazing permits on public range would decrease. If grazing fees on public ranges decreased as income to land fell, demand for grazing permits would increase, unless costs of private land also decreased. If grazing fees and costs of private land, as taxes and interest, could each be varied in exactly the same way as income to land changed, demand for grazing permits would remain relatively stable in years of high and low prices.

Present grazing fees on Federal range lands do not vary according to variations in income to land, or at least do so only to a minor degree. The Division of Grazing charges a uniform fee of 5 cents per head per month for cattle and 1 cent per head per month for sheep, on all grazing districts in all parts of the West. This fee has generally been regarded as temporary, to be used during the period of temporary licenses, and subject to modification when term permits are issued. The Forest Service charges a fee which varies between forests, according to the value of the grazing as determined by a careful and detailed appraisal. This fee averaged 14.5 cents per head per month for cattle and 4.5 cents per head per month for sheep in 1931. Grazing fees are adjusted annually. "Fees for any given year will bear the same ratio to the 1931 rate as the ratio which the average prices received by producers in the eleven western States for the year preceding the year for which the fees are to be adjusted bear to the corresponding average prices during the period from 1920 to 1932 inclusive in the case of sheep, and during the period from 1921 to 1930 inclusive in the case of cattle." 6/ Cattle prices in the base period were $6.62 per 100 pounds, and were $6.84 in 1937. Hence, the 1938 grazing fee is 14.98 cents per head per month, or 3.3 percent above the base fee, since cattle prices in 1937 were an equal percentage above the base period. As fees are paid at the beginning of the grazing season, out of income secured from sale of animals the fall before, it is logical to compute fees for a given year on the basis of livestock prices of the preceding year. Grazing fees on individual forests vary up and down according to livestock prices, but maintain the difference due to differences in productivity.

If it is desired that grazing fees, interest, or principal payments vary in order to bear some relatively constant ratio to income to land, it should be obvious from figures 2 and 3 and tables 7 and 8 that any type of charges for use of land should not vary in simple proportion to changes in livestock prices. For instance, in the post-war years when beef was $7.27 per 100 pounds, income to land per month of grazing was 20 cents; when beef price increased 10 percent, or to $8 per 100 pounds, income to land per month of grazing increased to 33 cents, or an increase of 65 percent. Illustrations of this point could be multiplied indefinitely. In the post-war period, a rise in income to land of 100 percent, or from 20 to 40 cents per month of grazing, was brought about by a 15-percent rise in the price of beef, from $7.27 to $8.38 per 100 pounds.

If half of a rancher's land charge is fixed in amount, and does not vary from year to year, the remaining sum attributable to land varies greatly from year to year. For instance, a given rancher might have a tax and interest charge on land equal to 12 cents per animal-unit month, or about half of the income to land secured by the average cattle ranch in Montana from 1910 to 1936. In the 1921-26 period, when the average rancher's income to land was zero or minus, the rancher with fixed land charges of 12 cents per animal-unit month would have had to meet $1,728 in fixed land costs from some source other than income to land. In 1928 and 1929, when the average rancher secured an income to land of over 60 cents per animal-unit month, a fixed charge of 12 cents would have left a large amount of money to capitalize or otherwise use. The man who has fixed charges on part of his land has a widely varying sum available as income to land on the remainder of his land.

6/ U. S. Department of Agriculture Press Release, May 29, 1933.

A Simple Formula

Although income to land does not vary in simple proportion to livestock prices, in the sense that a 10-percent increase in prices means a 10-percent increase in income to land, there is, nevertheless, a direct relation between the two which may be expressed by a rather simple formula. Gross income from 200 animal units in cattle was $4,000 (Page 5) when cattle price was $6.50 per 100 pounds. For each $1 of cattle price per 100 pounds, a gross income of $615.38 was secured. Labor cost $1,600 in the 1929-33 period when the combined index of farm family living and farm wages was approximately 125. For each point of this index, therefore, labor cost was $12.76. Similarly referring to table 3 for the data on costs and indexes, the general, feed, and depreciation expenses were $6.78 for each point on the index of farm production costs and taxes were $0.88 for each point on the index of taxes. Interest on investment in cattle and equipment was $600 on the 200-animal-unit cattle ranch when cattle were selling for $6.50 per 100 pounds, or was $92.31 for each dollar of cattle price. There were 2400 animal unit months feed required annually for the 200 animal units of cattle.

Combining these various ratios, the calculations in tables 3 and 6 are reducible to the following formula:

$$\text{Land income per a.u. mo.} = \frac{615.38\ A - (12.76B + 6.78\ C + .88\ D + 92.31\ A)}{2400}$$

When

A = Montana farm price of beef, calendar year average

$$B = \frac{(\text{Index of farm family living}) + (\text{index of farm wages})}{2}$$

C = Index of farm production costs

D = Index of taxes.

Income to land increases with each rise in beef prices, and becomes less with each rise in family living costs, wages, farm-production costs, or taxes. The price of beef appears among the cost items, since interest on investment in cattle was included as a cost and the amount of investment was assumed to vary in proportion to the price of beef. The income to land per animal-unit month was obtained by dividing total income to land by 2,400, the number of animal-unit months of feed required.

This formula was constructed on the assumption that prices were the only variables; that physical production of beef and quantities of raw materials used per head were the same in each year. This simple formula could be made more complex by including the effect of varying climatic or other factors. Instead of the coefficient 615.38 (multiplied by the price of beef), a different coefficient might have been used, depending upon whether beef production per head was above or below average. A different factor might also be used, to multiply by the index of production costs, depending upon the quantity of production materials used in a particular year. In order to serve as the basis for periodic determination of grazing fees, a formula would have to be based upon accurate data as to production, dates, prices, costs, and other items.

The formula given above may yield a negative income to land, as indeed may any formula which approximates actual conditions. A negative income to land might be taken to mean that the Federal or State Government should pay the range user for his use of the range. Such a program would probably meet with serious opposition and possibly with legal obstacles as well. The rancher probably should be expected to carry the burden of negative income himself. Calculation of grazing fees, interest charges, or principal repayments might be modified in such a way that the amount paid would be zero when the income to land was zero or negative; and in other years might be a percentage of the amount calculated by the formula. For instance, the average value of a month's grazing for cattle as shown in table 6 was 25 cents; if we eliminate the years of negative income to land, this value is increased to 28 cents. If a charge was made equal to 89 percent of the value calculated by the formula in years when income to land was positive, and no charge was made in years when income to land was negative, the average charge over the 27-year period would have been the same as if negative and full-formula charges were made.

If it was desired to vary land charges of any kind in proportion to changes in income to land, this might be done in one of several ways. Some modification of the above formula might be used, or the calculations of purchasing-power index for "other cattle" and for sheep, made by the Bureau of Agricultural Economics, might be substituted. Land charges might be varied annually, as the index changed, or they might be varied only when purchasing power changed in excess of a specified amount, as 5, 10, or 20 percent.

In evolving a practical program of operation, loan agencies and range administrators would have to consider the possibility of varying interest payments or fees according to variations in climatic and other physical conditions. Variation in land charges according to price conditions may meet only partially the needs of the man whose production has been sharply reduced by circumstances out of his control. The chief objection to varying fees according to production conditions is the administrative difficulty of so doing. Shall only widespread and general climatic conditions be considered, or shall local conditions also be included? What shall be the measure of production conditions, and how shall it be applied? Allowance for price changes and allowance for production conditions could be made separately or together.